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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]Adsorbent or an absorbent is used for this invention, and it relates to the dehumidifying/humidifying device which can perform absorption reproduction which emits moisture into the adsorption and desorption which suck up the moisture in the air, or the air good.
[0002]
[Description of the Prior Art]As such a conventional dehumidifying/humidifying device, the air flow rate which passes an adsorption part at the time of adsorption and desorption is decreased temporally, and there is a thing to which the air flow rate which passes an adsorption part at the time of absorption reproduction is made to increase temporally as described in the Japanese-Patent-Application-No. No. 64842 [four to] gazette. Here, at the time of absorption reproduction, adsorbent or the air humidified is heated with the heater.
[0003]The adsorbent refers to the solid which generally sucks up the moisture contained in gases, such as air. On the other hand, the absorbent refers to the fluid which generally sucks up the moisture contained in gases, such as air.
[0004]
[Problem(s) to be Solved by the Invention]However, in the above-mentioned conventional dehumidifying/humidifying device, since the electric heater is used for adsorbent or heating of air humidified, great power consumption and a lot of adsorbent will be needed.
[0005]That is, the characteristic of adsorbent becomes a thing as about shown in drawing 2, and, in the one where the relative humidity on the surface of adsorbent (saturated steam partial pressure in the steam partial pressure / adsorbent skin temperature of adsorbent ambient air) is higher, surface coverage (adsorption moisture mass / adsorbent mass) becomes high. Therefore, when desorbing moisture from adsorbent, in adsorbent, it is setting

heating, i.e., relative humidity, to psia from psib, and the mass of the decrement (omegab minus omegaa) x adsorbent of the surface coverage at that time turns into a desorption moisture content.

[0006]However, since the efficiency (calorific value/input electric energy) of an electric heater is 1 at the maximum, much input electric energy is needed for desorption of adsorbent.

[0007]In the above-mentioned conventional dehumidifying/humidifying device, since the air before adsorbing is taken in as it is, when air temperature is comparatively high, relative humidity will rise because adsorbent skin temperature rises, and surface coverage will fall. Therefore, in order to secure the required moisture content used for humidifying air, such as the interior of a room, many adsorbent will be needed, and it will be necessary to shorten the cycle of adsorption and desorption, and the heating quantity of adsorbent will increase.

[0008]Then, an object of this invention is to be able to use adsorbent or an absorbent, and to be able to reduce the initial complement of adsorbent or an absorbent in the dehumidifying/humidifying device which carries out absorption reproduction which emits moisture into the adsorption and desorption which suck up the moisture in the air, or the air, and to provide the dehumidifying/humidifying device which is low power consumption.

[0009]

[Means for Solving the Problem]In a dehumidifying/humidifying device which humidifies by making moisture which a dehumidifying/humidifying device of this invention dehumidified by making adsorbent suck up moisture in the air, and adsorbent held emit, In a refrigerating cycle which consists of a compressor, a condenser, an expansion mechanism, and an evaporator, either [at least] heating of said adsorbent or the cooling are performed.

[0010]An air ventilation flue where a dehumidifying/humidifying device of this invention circulates the open air and indoor air, In a dehumidifying/humidifying device which has a blowing means to which it is arranged in said air ventilation flue, and adsorption and desorption and adsorbent which carries out absorption reproduction and the open air in said air ventilation flue, and indoor air are moved, [moisture / in the air] In a refrigerating cycle which consists of a compressor, a condenser, an expansion mechanism, and an evaporator, either [at least] heating of said adsorbent or the cooling are performed.

[0011]As for a dehumidifying/humidifying device of this invention, in the time of humidifying operation, it is preferred to perform heating of adsorbent to the condenser side in a refrigerating cycle.

[0012]As for a dehumidifying/humidifying device of this invention, in the time of dehumidification operation, it is preferred to carry out using a refrigerant which passed an expansion mechanism [in / for cooling of adsorbent / a refrigerating cycle].

[0013]As for a dehumidifying/humidifying device of this invention, it is preferred to divide into the 1st adsorbent and the 2nd adsorbent adsorbent arranged in an air ventilation flue, to

arrange it, to perform heating of said 1st adsorbent to the condenser side in a refrigerating cycle, and to perform cooling of said 2nd adsorbent to the evaporator side in a refrigerating cycle.

[0014]A dehumidifying/humidifying device of this invention has established an opening and closing means which intercepts that the open air and indoor air touch adsorbent in an air ventilation flue, and it is preferred to control dehumidification-and-humidification operation by controlling said opening and closing means.

[0015]As for a dehumidifying/humidifying device of this invention, it is preferred to use a refrigerating cycle used for heating and cooling of adsorbent for a refrigerating cycle of a conditioner which adjusts temperature and humidity of indoor air, and common use.

[0016]As for a dehumidifying/humidifying device of this invention, it is preferred to collect heat which adsorbent generates by a refrigerating cycle.

[0017]As for a dehumidifying/humidifying device of this invention, it is preferred that adsorbent performs simultaneously heat exchange with a fluid in piping in a refrigerating cycle and adsorption and desorption of moisture with ambient air of the adsorbent.

[0018]An absorbent may be used for a dehumidifying/humidifying device of this invention instead of adsorbent mentioned above.

[0019]

[Function]The water absorption capability and moisture discharge capability of adsorbent can be heightened more by raising the temperature of the adsorbent, or lowering. In this dehumidifying/humidifying device, since heating or cooling of the adsorbent is performed in a refrigerating cycle, power consumption can be reduced from the case where adsorbent is heated using an electric heater etc.

[0020]By cooling adsorbent in a refrigerating cycle, since the adsorption capability of adsorbent can be made to increase, the amount of required adsorbent can be reduced.

[0021]The amount of dehumidification and humidification can be finely tuned by establishing further again the opening and closing means which intercepts that the open air and indoor air touch adsorbent in an air ventilation flue, and controlling the opening and closing means.

[0022]By using further again the refrigerating cycle used for heating and cooling of adsorbent for the refrigerating cycle of the conditioner which adjusts the temperature and humidity of indoor air, and common use, at the same time as it adjusts the temperature of indoor air, the humidity of the indoor air can be adjusted arbitrarily.

[0023]

[Example]Hereafter, the example of this invention is described with reference to drawings.

[0024]Drawing 1 is an outline lineblock diagram showing the dehumidifying/humidifying device concerning the 1st example of this invention. This dehumidifying/humidifying device has an air ventilation flue provided with the exhaust port 8, the outdoor air intake 9, the air supplying

opening 10, and the indoor air intake 11 as an air ventilation flue which circulates the open air and indoor air.
[0025]let the adsorbent 2 be a subject into the air ventilation flue -- it is arranged absorption unit 4. The adsorbent 2 is adsorption and desorption and a solid member which carries out absorption reproduction about the moisture in the air.
Specifically, zeolite, activated alumina, silica gel, etc. are used.

[0026]These adsorbent has the characteristic as generally shown in drawing 2. That is, in the one where the relative humidity on the surface of adsorbent (saturated steam partial pressure in the steam partial pressure / adsorbent skin temperature of adsorbent ambient air) is higher, surface coverage (adsorption moisture mass / adsorbent mass) becomes high. Therefore, when desorbing moisture from adsorbent, in adsorbent, it is setting heating, i.e., relative humidity, to psia from psib, and the mass of the decrement (omegab minus omegaa) x adsorbent of the surface coverage at that time turns into a desorption moisture content.
[0027]In the air ventilation flue, the 2nd blower fan 17 and the 1st damper 12, the 2nd damper 13, the 3rd damper 14, and the 4th damper 15 are equipped as a blowing means to which the open air and indoor air are moved.
[0028]In the air ventilation flue, a part of piping of the refrigerating cycle which has the compressor 1, the expansion valve 6, the 1st blower fan 16, and heat exchanger 18 grade is introduced further again.
The adsorbent 2 is arranged around the piping.

[0029]Here, the adsorption unit 4 is having structure as shown in drawing 3. As shown in a figure, the adsorbent 23 is enclosed in the mesh container 22 which is a container which consists of reticulate members. Furthermore inside the mesh container 22, the refrigerant pipe 21 which is a part of piping of a refrigerating cycle, for example, consists of copper pipes has penetrated.
[0030]And the adsorbent 2 can perform transfer of ambient air and moisture through a reticulate member while being heated or cooled with the refrigerant which flows through the inside of the refrigerant pipe 21.
[0031]The refrigerating cycle device which makes the adsorption unit 4 a condenser will be constituted by these. By the wall 20, into drawing 1, right-hand side is divided into the interior-of-a-room side, and left-hand side is divided at the outdoor side.
[0032]Next, operation of this dehumidifying/humidifying device is explained. Drawing 4 is an explanatory view of each damper in the dehumidifying/humidifying device shown in drawing 1 showing operation, respectively. here -- each of the 1st damper 12, the 2nd damper 13, the 3rd damper 14, and the 4th damper 15 -- a switching condition has two states, A mode and an B

mode.

[0033]When you make the moisture of the time of open air water adsorption, i.e., outdoor air, stick to the absorbent 2 first, let open, and the 3rd damper 14 and 4th damper 15 be close for B mode 12 of drawing 4, i.e., the 1st damper, and the 2nd damper 13.

[0034]Thereby, the open air enters in an air ventilation flue from the outdoor air intake 9, passes along the part of the 2nd damper 13, is ventilated with the 2nd blower fan 17, and faces to the adsorption unit 4. The adsorbent 2 adsorbs the moisture in the air, and the air of the remaining low humidity passes along the part of the 1st damper 12 by the adsorption unit 4, and is discharged by outdoor from the exhaust port 8 with it.

[0035]And after time fully passes and the amount of water adsorption of adsorbent is saturated, a damper is changed to A mode and the compressor 1 is worked. In the adsorption unit 4, the refrigerant gas of the high temperature high pressure first compressed with the compressor by this is radiated for it heat and condensed to the adsorbent 2, and is decompressed in the expansion valve 6. The decompressed refrigerant absorbs the heat of the air sent with the 1st blower fan 16 in the 1st heat exchanger 18, evaporates, and returns to the compressor 1 again.

[0036]That is, these operations serve as a refrigerating cycle which makes the adsorption unit 4 a condenser. Then, indoor air enters from the indoor air intake 11, passes along the part of the 4th damper 15, is ventilated with the 2nd blower fan 17, and faces to the adsorption unit 4.

[0037]Adsorbent is heated by a refrigerating cycle and the skin temperature of adsorbent goes up it by the adsorption unit 4. the moisture to which it became impossible to be unable to stick since surface coverage decreased as the relative humidity on the surface of adsorbent falls and it is shown in drawing 2 in connection with it by this -- the discharge (desorption) from adsorbent -- last ** Thereby, the air sent from the interior of a room serves as high humidity, passes along the part of the 3rd damper 14, passes along the air supplying opening 10, and returns indoors again.

[0038]After time passes enough and moisture desorbs from the adsorbent 2 enough, the compressor 1 is suspended, each damper is again changed to an B mode, and adsorption of open air moisture is started.

[0039]By repeating such a cycle, the adsorption and desorption of the moisture to the adsorbent 2 are repeated, and humidification by the method of introducing the moisture of outdoor air to the interior of a room is performed.

[0040]In the above operation, since the refrigerating cycle whose efficiency is higher than an electric heater is used for heating of the adsorbent 2, power consumption can be reduced from the case where an electric heater is used.

[0041]Since the moisture of indoor air can be made to be able to stick to the adsorbent 2 and the moisture can be emitted to outdoor if it uses making it stop at the time of A mode, and

working the compressor 1 at the time of an B mode, indoor air can be dehumidified.
[0042]Next, the 2nd example of this invention is described. Drawing 5 is an outline lineblock diagram showing the dehumidifying/humidifying device concerning the 2nd example of this invention. The point of difference with the dehumidifying/humidifying device shown in drawing 1 is a point of having formed the four-way valve 7 in the refrigerating cycle.
[0043]Thereby, in this dehumidifying/humidifying device, it can carry out in the time of dehumidification operation using the refrigerant which passed the expansion valve [in / for cooling of the adsorbent 2 / a refrigerating cycle] 6.
[0044]Next, concrete operation of this dehumidifying/humidifying device is explained. It changes so that the adsorption unit 4 may become a condenser from the adsorbent 2 about the four-way valve 7 at the time of the desorption which emits moisture, and each damper is made into the B mode shown in drawing 4, and other operations are made to be the same as that of the 1st example mentioned above.
[0045]On the other hand, at the time of the adsorption which makes the adsorbent 2 absorb moisture, it is considered as A mode which the compressor 1 is not stopped, and the four-way valve 7 is switched, and shows each damper in drawing 4. Thereby, the refrigerant gas of the high temperature high pressure compressed with the compressor 1 passes along the four-way valve 7, emits and condenses heat to the air sent with the blower fan 16 in the 1st heat exchanger 18, decompresses it by the expansion valve 6 further, and faces to the adsorption unit 4.
[0046]By the part of the adsorption unit 4, a refrigerant carries out the endothermic of the heat of the adsorbent 2, evaporates, and returns to the compressor 1 again. At this time, outdoor air enters in an air ventilation flue from the outdoor air intake 9, passes along the part of the 2nd damper 13, is ventilated with the blower fan 17, and faces to the adsorption unit 4.
[0047]In the adsorption unit 4, moisture is adsorbed by the adsorbent 2 and the peripheral air turns into air of low humidity. The air of the low humidity passes along the part of the 1st damper 12, and is exhausted by outdoor from the exhaust port 8.
[0048]Here, the adsorbent 2 is cooled by the refrigerating cycle. And since the skin temperature of adsorbent falls as shown in drawing 2, relative humidity goes up and surface coverage increases in connection with it.
[0049]While adsorption efficiency can improve and being able to reduce the amount of required adsorbent rather than the case where adsorbent is not cooled, by these, dehumidification-and-humidification capability can be raised. Adsorbent is immediately after desorption, and although it is an elevated temperature immediately after the change of each damper, since it is cooled by a refrigerating cycle device, it can shorten the cycle of adsorption and desorption, i.e., the change interval of A mode and an B mode, and can raise dehumidification-and-humidification capability further.

[0050]On the other hand, in the refrigerating cycle side, since evaporating pressure can rise, the compression-pressure ratio of the compressor 1 can decrease, since evaporating temperature rises with the heat of adsorption which adsorbent generates, and the power consumption about a compressor, etc. can be reduced, the coefficient of performance of a refrigerating cycle can be raised.

[0051]Next, the 3rd example of this invention is described. Drawing 6 is an outline lineblock diagram showing the dehumidifying/humidifying device concerning the 3rd example of this invention. About the dehumidifying/humidifying device of the 2nd example shown in drawing 5, this dehumidifying/humidifying device connects the 2nd adsorption unit 5 to the portion of the 1st heat exchanger 18, and it constitutes it so that it may become in parallel with the 1st adsorption unit 4.

[0052]That is, in this dehumidifying/humidifying device, while dividing into the 1st adsorbent 2 and the 2nd adsorbent 3 the adsorbent arranged in an air ventilation flue, arranging it and performing heating of the 1st adsorbent 2 to the condenser side in a refrigerating cycle, it is supposed that cooling of the 2nd adsorbent 3 is performed to the evaporator side in a refrigerating cycle.

[0053]In order to realize such operation, about in-and-out of the air to each adsorption unit, the change state of the 1st damper 12, the 2nd damper 13, the 3rd damper 14, and the 4th damper 15 is chosen from one of the C mode shown in drawing 7, D mode, the E mode, and F modes. The change about the four-way valve 7 is also chosen from one of the C mode shown in drawing 7, D mode, the E mode, and F modes.

[0054]Next, concrete operation of this dehumidifying/humidifying device is explained. The refrigerant gas of the high temperature high pressure compressed with the compressor 1 in the refrigerating cycle when each state of the 4th damper 15 and the four-way valve 7 considered it as the C mode shown by drawing 7 from the 1st damper 12 first is the other side to the 1st adsorption unit 4. The refrigerant gas radiates for it heat and condenses heat to the 1st adsorbent 2, is decompressed by the expansion valve 6, toward the 2nd adsorption unit, the endothermic of it is carried out, it evaporates from the 2nd adsorbent 3, and returns to the compressor 1 again.

[0055]At this time, outdoor air passes along the part of the 2nd damper 13 from the outdoor air intake 9, and faces to the 2nd adsorption unit 5. In the 2nd adsorption unit 5, moisture is adsorbed by the 2nd adsorbent 3 and the outdoor air turns into air of low humidity. The air of the low humidity passes along the part of the 1st damper 12, and is exhausted by outdoor from the exhaust port 8.

[0056]The air of further this time interior of a room passes along the indoor air intake 11, passes along the part of the 4th damper 15, and faces to the 1st adsorption unit 4. In the 1st adsorption unit 4, the indoor air obtains moisture from the 1st adsorbent 2 currently heated by

the refrigerating cycle, and turns into air of high humidity. The air of the high humidity passes along the part of the 3rd damper 14, and is indoors ventilated from the air supplying opening 10.

[0057]And after time passes enough and desorption of the 1st adsorbent 2 and adsorption of the 2nd adsorbent 3 are completed, each damper and the four-way valve 7 change to the mode D in drawing 7, the 1st adsorbent 2 starts adsorption and the 2nd adsorbent 3 starts desorption.

[0058]If the mode E and the mode F in drawing 7 are repeated, dehumidification of indoor air will be performed.

[0059]As mentioned above, since this dehumidifying/humidifying device arranges two adsorption units in parallel and performs heating and cooling of each adsorbent on the both sides of the condensation [of a refrigerating cycle], and evaporation side, respectively, it can perform humidification or dehumidification continuously. Since condensation temperature can be gone up if it is the part and the same compressor input which obtained the heat of adsorption which adsorbent has in the refrigerating cycle side and to which evaporating pressure rose since heating and cooling of adsorbent were performed simultaneously, The heat of adsorption of adsorbent can be used for heating for desorption of the adsorbent of another side as a result [while].

[0060]Next, the 4th example of this invention is described. Drawing 8 is an outline lineblock diagram showing the dehumidifying/humidifying device concerning the 4th example of this invention. This dehumidifying/humidifying device divides an adsorption unit into the heat exchanger for an adsorbent simple substance, heating of adsorbent ambient air, or cooling about the dehumidifying/humidifying device of the 3rd example shown in drawing 6.

[0061]Operation of this dehumidifying/humidifying device is the same as that of the 3rd example by heating or cooling ambient air of adsorbent except the point which heats or cools the adsorbent surface. However, when the degradation by the long term deterioration of adsorbent becomes remarkable by having formed adsorbent alone, without using an adsorption unit, it is effective in adsorbent being easily exchangeable.

[0062]Next, the 5th example of this invention is described. Drawing 9 is an outline lineblock diagram showing the dehumidifying/humidifying device concerning the 5th example of this invention. This dehumidifying/humidifying device forms the 5th damper 24 in an air ventilation flue so that it can emit to the interior of a room or outdoor, without the air which passed along the heat exchanger passing along the circumference of adsorbent about the dehumidifying/humidifying device of the 4th example shown in drawing 8.

[0063]That is, in the air ventilation flue, the 5th damper 24 is formed as an opening and closing means which can intercept that the open air and indoor air touch adsorbent, and dehumidification-and-humidification operation is controlled by controlling the 5th damper 24.

[0064]Next, concrete operation of this dehumidifying/humidifying device is explained. Here, drawing 10 is an explanatory view showing operation of the 5th damper 24 in the dehumidifying/humidifying device shown in drawing 9. First, when the 5th damper 24 is in G mode shown in drawing 10, it becomes the same operation as the 4th example shown in drawing 8.

[0065]this time -- the damper 12 to the 1st damper 15 and four-way valve 7 -- humidification -- ****** -- since the air which heated adsorbent is indoors introduced as it is when set up like (C or D mode of drawing 7), the air conditioning by the side of the interior of a room will be in the same state as humidification heating being performed. [4th]

[0066]On the contrary, since the air which cooled adsorbent is indoors introduced as it is when being set up so that dehumidification may be performed (E or F mode of drawing 7), the air conditioning by the side of the interior of a room will be in the same state as dehumidification air conditioning being performed.

[0067]On the other hand, since it is emitted to the interior of a room or outdoor, without the air heated or cooled passing along the circumference of adsorbent by a heat exchanger (18 or 19) when the 5th damper 24 serves as the H mode in drawing 7, it becomes the conventional air-conditioner and an air conditioner only by the same refrigerating cycle device.

[0068]As mentioned above, since the refrigerating cycle device used for heating or cooling of adsorbent is used for this dehumidifying/humidifying device also as a refrigerating cycle device for heating of indoor air, or cooling, Conventionally, the indoor humidity which was changing in connection with the temperature change according to the development of situation can be controlled now arbitrarily and with high precision, and comfortable indoor environment can be provided.

[0069]In an above-mentioned example, although the adsorbent which is a solid is used as a member which emits moisture into the member which absorbs the moisture in the air, and the air, this invention is not limited to this and can also use the absorber which consists of fluids, such as a lithium bromide or a lithium chloride, for example.

[0070]

[Effect of the Invention]As explained above, in this invention, either [at least] heating of adsorbent or the cooling are performed in a refrigerating cycle.

Therefore, compared with the case where adsorbent is heated using an electric heater etc., a dehumidifying/humidifying device with little power consumption can be provided.

In this invention, when making the moisture in the air stick to adsorbent, by cooling the adsorbent, the amount of water adsorption per unit mass of adsorbent can be raised, and the amount of required adsorbent can be reduced.

[Translation done.]